


## Subject: Management

Production of Courseware

 -Content for Post Graduate Courses



Paper 6: Management Information System

Module 40: Maintenance of Systems



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Items	Description of Module
Subject Name	Management
Paper Name	Management Information System
Module Title	Maintenance of Systems
Module Id	Module No.- 40
Pre- Requisites	Understanding of components that form the IS and process of system development life cycle.
Objectives	To understand the need and importance of maintenance of information systems.
Keywords	Corrective, adaptive, preventive, perfective maintenance, software localization, connectivity, reliability, control, user participation

## QUADRANT-I

Module-39 Risk Analysis
1. Learning Outcome
2. Introduction
3. Why is Maintenance necessary?
4. Control, Reliability, User Participation, and Training Model
4.1 Categories of Maintenance.
5. Coordination of Maintenance activities.
6. Connectivity Issues and Local Support.
6.1 Managing cost of System Maintenance.
7. Summary

### 1. Learning Outcome

After completing this module the students will be able to:

- ❖ Understand the basic concept of Maintenance of Systems.
- ❖ Get an overview why system maintenance is necessary?
- ❖ Understand the CRUT Model of maintenance and categories of Maintenance?
- ❖ Discuss the coordination of maintenance activities.
- ❖ Discuss connectivity issues and local support of maintenance systems.
- ❖ Understand the various factors that affect cost of maintenance systems.

### 2. Introduction

Information Systems are a boon to organizations as they enable and automate numerous functions that aid business. It is inevitable for the Information System Ecosystem to be updated and well maintained to ensure quality, reliability and consistency of the operations. Customers may assess the quality of an organizations' system by evaluating the level of the services preferred and the lowest level of services that customers are willing to accept.



Exhibit 1: System Maintenance

Image Source: <https://mindtouch.com/engineering-our-success/wp-content/uploads/sites/8/2017/01/wordpress-website-maintenance-service.jpg>

System maintenance is essential to ensure that information systems are well maintained and there is a contingency plan in the event of any service disruption. The infrastructure for Information Systems can be categorized as hardware, software, and information system and file maintenance. Hardware maintenance implies the test and cleaning of the apparatus. Information system maintenance refers to updating of master files, such as adding and deleting employee and customer data and changing credit limits and product prices. Software maintenance refers to necessary updates and upgrades in order to meet changing information requirements like adding new functions and changing data formats. It also includes debugging and adapting the software to new hardware devices. Disk or file maintenance is the periodic reorganizing of disk files that have become fragmented due to continuous updating. Despite best efforts in the ever changing dynamic marketplace, it remains a challenge for management to consider various ways of preserving the integrity of the systems. IS maintenance can be conducted through systems control, reliability, user participation, and training. The process of coordination deals with the assessment, planning and scheduling of maintenance activities; taking into account operations, maintenance, and engineering requirements.



Exhibit2: Maintenance Activity Calendar

Image Source: [http://www.weibull.com/basics/scheduled\\_maintenance.png](http://www.weibull.com/basics/scheduled_maintenance.png)

In any organization, small or big a major portion of the time goes in data collection, processing, documenting and communicating it to the people. It is necessary to review the system periodically and identify the improvements required. In today's world of ever increasing complexities of business as well as management, every organization to survive and grow must have an efficient and effective MIS. An effective Management Information System supplies accurate, relevant and timely information to the manager of an organization. It plays a vital role of information generation, communication, problem identification and helps in the process of decision making for effective management, administration and operations of an organization.



Exhibit 3: A System Maintenance Layout

Image Source: <http://www.samsimo.com/wp-content/uploads/2014/08/infrastructure-design.png>

### 3. Why is System Maintenance Necessary?

Selling software and services is a completely different scenario from selling hardware. Moreover, selling solutions require integration of software, hardware and compatible networking that enables the system to deliver what it aims to. Communication and business activities constantly need a smooth, interoperable, customizable and scalable platform to increase capacity and adapt to changing business needs. This is undoubtedly not a onetime activity but an ongoing one. The reason for designing a computerized management information system for the maintenance activity is to give the best assistance to management

for routine decisions in order to achieve maximum uptime and service restoration.

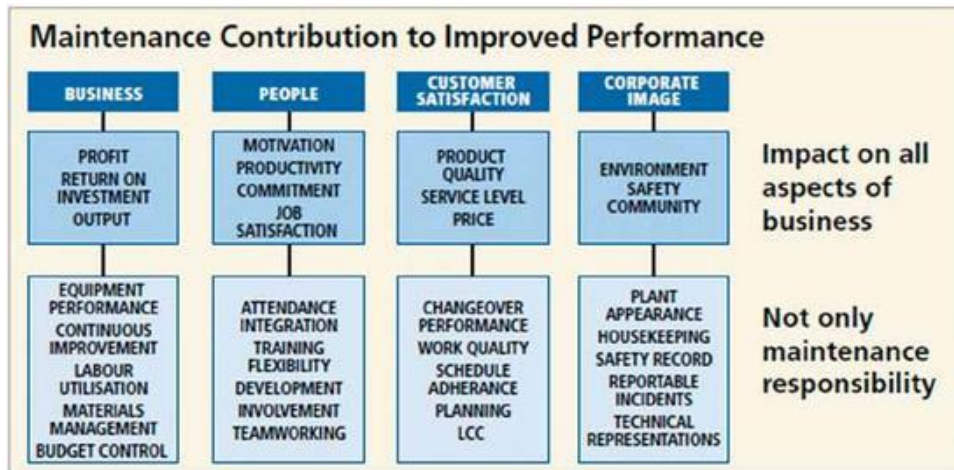


Exhibit4: Maintenance – Value Proposition

Image Source: [http://www.maintworld.com/var/ezwebin\\_site/storage/images/media/images/figure-150/3772-1-eng-GB/Figure-1\\_imagelarge.jpg](http://www.maintworld.com/var/ezwebin_site/storage/images/media/images/figure-150/3772-1-eng-GB/Figure-1_imagelarge.jpg)

The MIS has many roles to perform like the decision support role, the performance monitoring role and the functional support role. An information system comprises of all the components that collect, manipulate, and disseminate data or information. It comprises hardware, software, people, and communications systems. The activities involved include inputting data, processing of data into information, storage of data and information, and the production of outputs such as management reports. Many decisions are based on systems life cycles and technological analysis of equipment hence it is necessary to ensure best maintenance practices are followed. Maintenance is based on the combination of all technical, administrative and management activities of the life cycle of an asset, in order to keep it or return it to a state where it can perform its required function.

The following reasons highlight the importance of system maintenance in the organizations.

- ❖ Incorporating change requires careful planning, monitoring and evaluation. Hence software maintenance can be stated as the modification of a software product after delivery to correct faults, to improve performance or other attributes. System maintenance is of paramount importance both from a technical and managerial view point.
- ❖ The management issues include alignment with customer priorities, staffing, and reengineering, estimating costs. Key technical issues imply limited understanding, impact analysis, testing, and maintainability measurement.
- ❖ Software is the key to information flow in an organization and a key to smooth running of business. It is a holistic activity that includes error correction, enhancements of capabilities, deletion of obsolete capabilities, and optimization. It is essential for mechanisms to be developed for evaluation, controlling and making modifications.
- ❖ It keeps the information systems functional and secure by making necessary alterations or corrections in the information systems. It is essential to document the use of and alterations made to the information systems administering user IDs, user accounts and access rights for information systems, and monitoring the operation and compiling statistics on them.

- ❖ Total cost of ownership must include the cost of system maintenance since these systems can help organizations implement their business strategy to decrease downtime, increase the use of their resources, reduce maintenance costs and ensure the key performance indications of business are maintained at expected levels.
- ❖ It is not just the technological parameters that change with time, but also the legal and business side of things. It is essential to stay on par with your competition, and with the latest legal requirements related to privacy and security of the users. Business patterns and government rules are also subject to constant change and improvement.
- ❖ Due to the huge costs associated with the maintenance activity the decision to go for maintenance and the amount of commitment to the task should be assessed keeping in mind the expected lifespan and usability of the software.

#### 4. Control, Reliability, User Participation, and Training Model

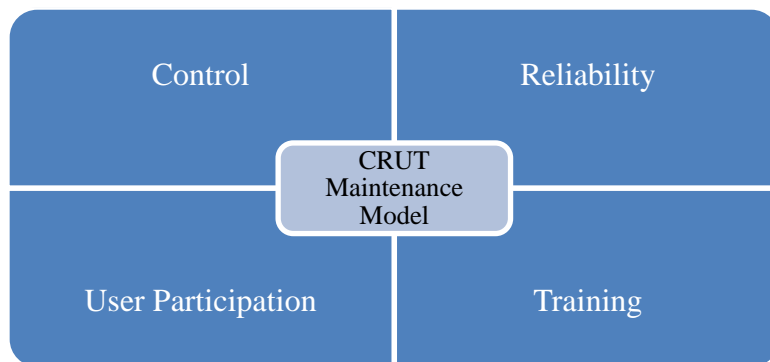


Fig1. CRUT Maintenance Model

As organizations increasingly adopt Information Systems, the management is mandated to pay attention to factors that would enable them to properly maintain the quality of the IS. Unless the system is properly maintained and managed, it cannot sustain business operations locally and globally. The elements in the CRUT model for IS maintenance are connected with each other. The element of control is central because without accurate control of IS, it would be difficult to determine the effectiveness of the systems. The elements of reliability, user participation, and training are included because they contribute to proper control of an organization's IS.

- ❖ *Control* - IS control is the beginning of data preservation in an organization. In responding to the research objectives, organizational management may preserve the quality of their organizational IS by exercising control over the systems. Management shall exercise control to uphold roles and responsibilities to avoid scope divergence, schedule slippages, and cost overruns. Management may use individuals who are qualified and experienced rather than purchasing enhanced systems that may accomplish the same tasks as their current systems. If the IS used are not properly controlled, the integrity of organizational data would be compromised. Organizations appoint project managers for effective planning and control of software development. When project managers are informed of the software needs of the organization, the management are better able to manage the IS effectively.



Exhibit5: Maintenance Schedule

Image Source: <http://www.rpluscrm.com/images/amc-management-software.jpg>

- ❖ *Reliability* - Reliability refers to dependable performance under obligatory circumstances for a pre-assigned time. Systems may not accomplish the intended tasks and information may be lost. Organizational management may determine if the IS are dependable based on how quickly they detect problems regarding their functions. IS that are unable to sense if a breach has occurred and has less security measures that would protect information may be considered untrustworthy. Hence, the timely upgrade of the system may be very important.
- ❖ *User Participation* - User participation in the quality of Information Systems is important for effective maintenance. IS user participation is the input of systems production services of the individuals who make use of IS on a regular basis, for instance, employees, customers, etc. On the other hand, IS user involvement refer to activities contributed by IS users on the development of IS, such as involvement in IS usage procedure manuals. IS users and manufacturers would work together on how to enhance a system to meet organizational needs. By involving employees in systems development, employees and management are more likely to develop a good relationship with IS producers. This relationship has the potential of creating training opportunities for IS developers and organizational management.
- ❖ *IS Training* - Offering various training programs for IS employees would enable them to use the systems to achieve the organizations' goals. IS participants should be accountable as users for their behavior and activities to achieve overall success on a project. In addition, organizational leaders should be responsible in ensuring that their staffs are informed as IS users through ongoing systems accountability training programs and the creation of training manuals.

#### **4.1 Categories of Maintenance**

Incorporating changes by the procedure of a change request is only a one sided approach to incorporate the needed change. In this phase requirements are articulated, analyzed, designed, checked for feasibility, tested and implemented. Primarily four basic categories of maintenance are identified as under and highlighted in figure 2.



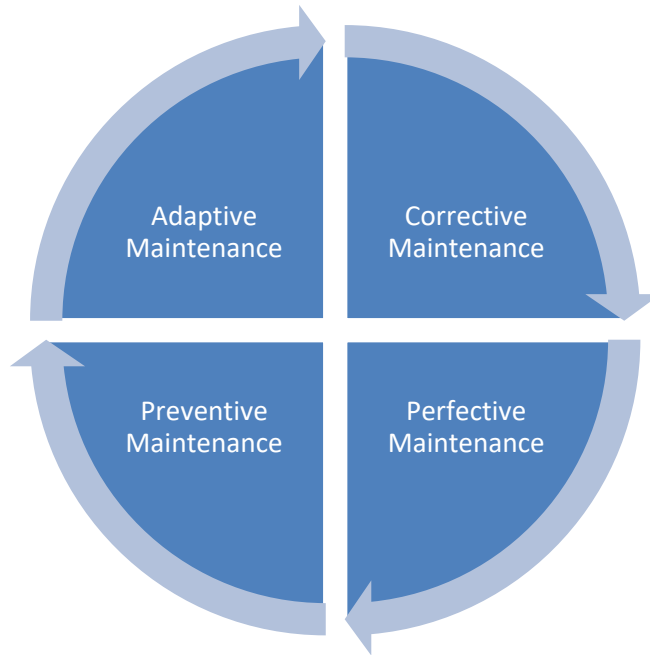


Fig2. Categories of Maintenance

- ❖ *Corrective Maintenance* – It focuses on fixing bugs and logic errors that are not detected during the implementation testing period. These errors may have crept in the system due to faulty design or wrong assumptions. Thus, in corrective maintenance, processing or performance failures are repaired.
- ❖ *Adaptive Maintenance* – It refers to activities associated with modifying existing functions or adding new functionality to accommodate changes in the business or operating environment. This type of maintenance may become necessary because of organizational changes which may include change in the organizational procedures, change in organizational objectives, goals, policies, and change in forms, information needs of managers and system controls and security needs.
- ❖ *Perfective Maintenance* – It implies the introduction of new programs or modifying the existing programs to enhance the performance of the information system. This type of maintenance undertaken to respond to user's additional needs which may be due to the changes within or outside of the organization. Outside changes imply environmental changes, which may in the absence of system maintenance; render the information system ineffective and inefficient. These environmental changes include changes in governmental policies, laws, economic and competitive conditions, and new technology.
- ❖ **Preventive Maintenance** – it involves activities intended to reduce chances of system failure or extend the capacity of a current system. Preventive maintenance is a high value adding function and vital to an organization realizing the full value of its investment in the system.

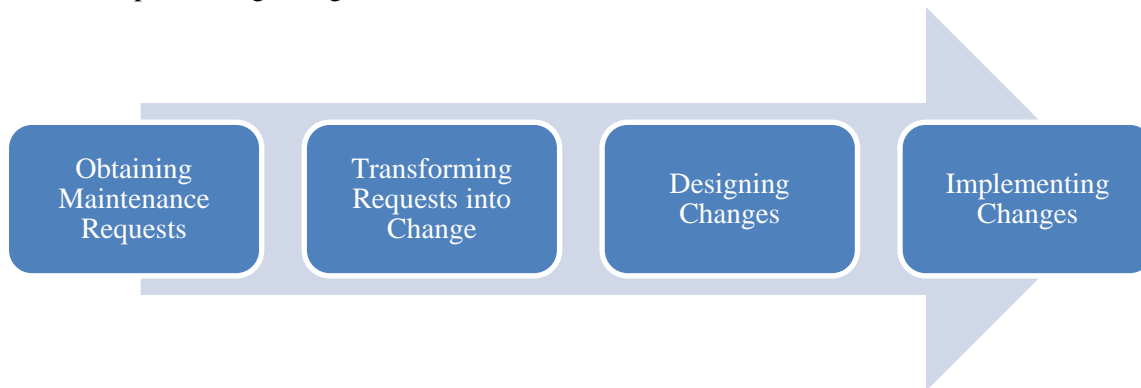


**Exhibit6: List of Maintenance Activities**

Source: <http://www.nihva.com/sites/default/files/maintance-service.png>

Four major activities occur within maintenance such as

- ❖ Obtaining maintenance requests
- ❖ Transforming requests into changes
- ❖ Designing changes
- ❖ Implementing changes



**Fig3. Major Activities in Maintenance Process**

The first phase of the SDLC is project identification and selection and is analogous to the maintenance process of obtaining a maintenance request. The SDLC phases of project initiation and planning and analysis are analogous to the maintenance process of transforming requests into a specific system change. The design phase of the SDLC equates to the designing changes process. Finally, the SDLC phase implementation equates to implementing changes. This similarity between the maintenance process and the SDLC is no accident. The concepts and techniques used to initially develop a system are also used to maintain it.

## 5. Coordination of Maintenance activities.



Exhibit7: Portfolio of Support and Maintenance Activities

Source: <http://static.progressivemediagroup.com/uploads/imagelibrary/nri/airport/clients/TAV%20IT/kusld.jpg>

In the information age, data has become one of the most important resources to organizations. The effective and efficient management of large quantities of data is a common problem found in many industries.

Most multinationals have geographically dispersed business functions. While the production and marketing could be a dispersed activity, the finance and research and development could be located at the headquarters. Many organizations allow their foreign subsidiaries to cater to the local markets focusing only on domestic functions and production. However this dispersed global scenario, can create a chaos of hardware, software and telecommunication networks. There could be incompatibility; difference of technology protocols and other inter country differences. Hence lays the need to focus on global systems strategies to streamline operations and communications to spearhead business operations locally and synchronize them globally.

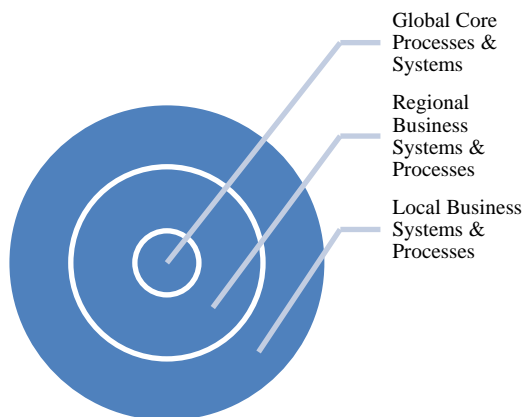


Fig4. Geographical System Scope

Working at a global level, requires a careful choice of strategy. There involves complications to ensure that all local system users are in sync with the global firm and use same versions of software. It is imperative for firms to institute procedures to ensure that all operating units convert to new software updates at the same time so that everyone's system is compatible.

It is inevitably to carry out maintenance activities with pre planned course of action to enhance the overall efficiency of the business processes and reduce the costly downtime which has its own repercussions from the client's perspective. It is essential to execute a process oriented view toward the maintenance activity where coordination and collaboration can become a critical factor.

The following feature set is commonly observed in a automated maintenance system.

- ❖ Generating work orders and assigning priority, tracking component which becomes sortable by equipment, date, person, and client.
- ❖ Scheduling of maintenance activities and indexing the warranty information by component for future reference.
- ❖ Documentation of procedures by component and real-time reports of ongoing work activity.
- ❖ Capital and labor cost tracking by component as well as critical and longest times to close a work order by component.
- ❖ Inventory control with automated reorder capability. Outside service call/dispatch capabilities.

## 6. Connectivity Issues and Local Support

Connectivity among individuals, firms, countries, and regions is increasingly understood as a key factor in achieving competitiveness and sustainable, inclusive economic growth. It refers to the ability to link together all entities such as systems, people of a global firm into a single integrated network capable of voice, data and image transmissions. The internet provides an enormously powerful foundation for providing connectivity among the dispersed units of a geographical firm. It is essential for the internet to provide a secure private network for transmission of sensitive data over multiple networks spanning geographies.



Exhibit8: System Support and Maintenance

Image Source: <http://www.adcvietnam.net/upload/image/bao-tri-website.png>

There is a necessity to build private secure networks for guaranteed service levels. Organizations use global intranets for internal communications and extranets to exchange information rapidly with business

partners in their supply chain. Virtual private networks provide the secure platform to be connected and carry business functions from any location worldwide.

The mere presence of the internet does not guarantee for information to flow seamlessly throughout the global organization because not all business units use the same applications. For example a German business unit may use Linux based collaboration tool to share documents and communicate, which is incompatible with American headquarters teams which use Lotus Notes.

Software Localization is the translation of a product's User Interface to overcome cultural barriers for their products to reach a much larger target audience. The best practices in localization of software involve transferring the intent of the original content and user interface from one language to another while maintaining usability. This concept is inevitable since organizations work in a global scenario and at times need to cater to critical issues in the local markets with respect to client specific requirements.

## 6.1 Managing cost of System Maintenance



Exhibit9: Annual Maintenance Contract

Image Source: <http://topvirt.co.in/wp-content/uploads/2016/12/sub-banner-27.jpg>

Corrective maintenance accounts the major chunk of the maintenance activity, the number of defects in a system influences most of the costs associated with maintaining a system. If there are no errors in the system after it is installed, then maintenance costs will be relatively low. If there are a large number of defects in the system when it is installed, maintenance costs will likely be high. Secondly, the maintenance costs are influenced by number of customers for a given system. Higher the number of customers, larger is the maintenance costs. A third major contributing factor to maintenance costs is the quality of system documentation.

The following techniques help reduce the cost of software maintenance to achieve desired results found in increasing productivity as well as making benefit of limited financial resources and manpower available



Exhibit10: Quality of Service  
 Image Source: <http://www.qosit.co.uk/images/quality-of-service-information-technology.png>

- ❖ Providing an effective tool for Software Maintenance by using appropriate language for system maintenance (especially in developing application systems) and develop tools to use these languages. Optimal use of system implementation such as CASE tools, programming standards and protocols Also the use of the principles, methods and modern programming techniques.
- ❖ Using proper techniques in software development on the basis of independent modules. The designing and programming using methods consistent with software engineering principles in software development. To build a cost effective maintenance mechanism system prototyping the system is important.




<b>MAINTENANCE CONTRACTS</b>	 <b>BRONZE</b>	 <b>SILVER</b>	 <b>GOLD</b>
Preventative maintenance visits	✓	✓	✓
Comprehensive engineers report	✓	✓	✓
Fully qualified personnel	✓	✓	✓
Free technical advice	✓	✓	✓
Priority response to emergencies	✓	✓	✓
No labour charges for emergency call outs	✓	✓	✓
24hrs per day 365 days per year	✗	✓	✓
No parts charge	✗	✗	✓

Exhibit11: Example of a Maintenance Contract  
 Image Source: <http://www.alliancetelecom.in/files/Maintenance-Matrix.png>

- ❖ Having the right people for the software maintenance such as professionals familiar with the project language and programming language. There should be familiarity of project group with the host machine and the target machine. An experienced group helps minimize product complexity on development and maintenance costs. Selecting individuals with the ability to analyze the project and coordinate teamwork is essential. Individuals with experience on the similar projects and the host machine shall be aware of the application and familiar with the expectations of the system.



- ❖ Considering future program structure and acceptability of changes. Need assessment based on the present situation and future trends for software maintenance. Changes in environment regarding software conditions increase maintenance costs.

## **7. Summary**

The cornerstone of an organization's security lies in designing, developing and implementing proper information systems' security policy that balances security goals with the organization's needs. Maintenance is an ongoing activity that keeps the MIS at the highest levels of effectiveness and efficiency within cost constraints. Maintenance is directed towards reducing errors due to design, reducing errors due to environmental changes and improving the system's scope and services. The sheer of volume of maintenance information can be staggering as the number of transactions for businesses with data repositories easily exceeds one million a month. A maintenance manager needs all the help available to keep track of who is doing what tasks, on what equipment, with what parts, and at what cost. Using software to track all maintenance activities becomes critical as more companies establish best practices to drive continuous improvement and develop KPIs to measure their progress; management support, strictly defined maintenance work processes, and ease of use have been identified as keys to success. Organizational management should plan carefully with IS developers to control and maintain the IS they utilize. IS reliability provides an early caution about the worth of the systems and recognizes problematic areas. As reliable IS are selected, management should consider involving employees in the IS production. These various activities create room for exploration of how Information System users and developers could better manufacture systems that suit organizations' objectives. Providing training for IS users within an organization is pertinent to help define IS users' roles and to determine accountability and understanding of IS. Thus, maintenance is one of the most important areas of the organizational structure, especially in industrial sector, as it contributes to faculties such as performance enhancement, security, interpersonal relationships and return on investment.